SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, OCTOBER 12, 1906.

CONTENTS.

The Future of Medicine: PRESIDENT CHARLES W. ELIOT 49

The Unity of the Medical Sciences: PROFESSOR WILLIAM H. WELCH 454

Scientific Books:—

Chamberlin and Salisbury's Geology: PROFESSOR J. C. BRANNER. *Gibbon's The Eye, its Refraction and Diseases:* DR. COLMAN W. CUTLER 462

Scientific Journals and Articles 466

Discussion and Correspondence:—

On the Doppler Effect: HORACE CLARK RICHARDS 466

Special Articles:—

Glacial Stages in Southeastern New England and Vicinity: M. L. FULLER. *Food Habits of the Snail, Bulimulus Dormani Binney:* PROFESSOR E. H. SELLARDS 467

Quotations:—

A National Department of Health 470

Technology—Harvard Geological Expedition. 471

Publications of the Carnegie Institution of Washington 472

Insanity in England and Wales 474

The Lowell Lectures 476

Scientific Notes and News 477

University and Educational News 480

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE FUTURE OF MEDICINE.[1]

THE future occupations and interests of the medical profession are to be in some respects different from those of the past, and they are to be more various. The ordinary physician has for the last hundred years been almost exclusively a man devoted to the treatment of diseases already developed in human bodies or of injuries already incurred. He made his diagnosis, and then sought remedies and a cure. He was the sympathetic and skilful helper of sick or injured persons. Most of the cases that came under his care were cases considered plain as to symptoms, period and accepted treatment. The minority of cases were obscure, and called for unusual knowledge and skill in discerning the seat of the disorder, or the approximate cause of the bodily disturbance. Hence the special value of the experienced consultant, who was ordinarily a man of some peculiar natural gift of body, mind or temperament, possessing also in high degree the faculty of keen observation, and the habit of eliminating irrelevant considerations, and ultimately finding his way to the accurate, limited inference from the facts before him. Both the ordinary physician and the consultant have already been much helped by the extraordinary progress made in medical science during the last thirty years; but they have been helped chiefly to a surer recognition of diseases established in human

[1] An address delivered by President Charles W. Eliot, on September 26, 1906, at the dedication of the Harvard Medical School.

bodies, and to a better treatment of their patients' diseases when recognized.

The physician or surgeon commonly renders a personal service to an individual, sometimes for a pecuniary recompense, but often without money compensation. He is often a trusted adviser in the most intimate family concerns. Births and deaths alike bring the physician into the home. In rendering these services he must be tender, sympathetic, considerate, pure-minded and judicious. There will always be need, crying need, of the physician and surgeon in this sense, and for these functions; and whatever else the regular education of the physician provides in the future, it must provide all the elements of the best training for the practising physician who is to treat diseased or crippled human bodies, and give advice about the sudden and the chronic ills which afflict humanity. So much will continue to be demanded of all good medical schools; but much more they must do.

The progress of what we call civilization exposes human beings more and more to the ravages of disease. When savages come in contact with men called civilized, they invariably suffer from diseases new to them. When a rural population crowds into cities, it falls a victim of diseases from which in the country it had been exempt. When hundreds of thousands of people huddle into small areas, and create there smoke, dust and noise, they suffer not only from new diseases, but from the exacerbation of diseases not wholly unknown to them in their rural condition. Under such unfavorable conditions of residence and labor the human body degenerates in many respects, and, losing vigor, becomes in some respects less able to resist the attacks of disease.

Against these bodily evils which result from civilization the physician has thus far struggled chiefly by treating more or less successfully the numerous individuals who are attacked by disease. Doubtless the treatment of sick and injured persons has substantially improved; but, nevertheless, the death-rate in our cities diminishes slowly, and the heavy economic losses which result from disease and premature death continue. Moreover, the improvement of treatment in hospitals and private practise has been accompanied by a great increase in the cost of treatment; so that the charges upon the community resulting from sicknesses and injuries have within the last thirty years rapidly mounted, and these heavy charges are, after all, incurred for the palliation of evils already suffered, and not for the prevention of such evils. Again, in different parts of the habitable globe mankind has been exposed for centuries to dangers more or less localized; in one region to the attacks of venomous reptiles, in another, of fierce carnivora, in another, to the ravages of flights of insects which devour every green thing, in another, to the constant presence of formidable diseases. For the most part, the human race has learnt how to exterminate the offending creatures, or at least to limit their ravages; and where grave infectious diseases are always present in greater or smaller degree, or frequently recur, a considerable proportion of the population becomes in some degree immune to them. Mankind is now in face of enemies which are not localized, but which, on the contrary, are carried all over the habitable globe on the ubiquitous routes of travel and commerce. The worst of the new enemies are minute, multitudinous and mysterious in that their relations and connections are unknown; they infest many of the animals with which man is associated, or pass into man from the animals and plants of which he makes use. Untrammelled dissemination of noxious

things has taken the place of centuries-long localization, a localization which sometimes secured checks, antidotes or immunities. Since, then, modern society can not help incurring new risks, it should seek new defenses. These defenses it may reasonably expect medical education to plan, and public and private expenditure to provide.

If civilized society is to endure under its new exposures and dangers, it is clear that the medical profession must take up with new ardor the work of preventing approaching disease in addition to the work of treating disease arrived. The profession must recognize that health is eminently a social product, just as the psychologists have recognized that the mind of a civilized man is a social product.

When we consider what has already been learnt about the production, transmission and prevention of smallpox, cholera, yellow fever, the black death, typhoid fever, diphtheria, anthrax, rabies and tetanus, we can not resist the conclusion that in the future medical science must include the study of causes and sequences which will carry the student through a large portion of the animal and vegetable kingdoms, and particularly into the habits and habitats of their minute parasitic forms. Systematic medical education must, therefore, produce a considerable number of men capable of studying in this region the causes of disease, and the ways of interrupting the means of communication, or breaking the chain of sequences, through which at last the germs of disease get a chance to produce their malignant effects within the human body. Considering the great obscurity of the physiological processes which go on within the body and the dense ignorance of mankind concerning the microscopic animal kingdom, it is a great wonder that medical science in its imperfect state has constructed so many effective defenses against disease within the last thirty years. Indeed, we are now using some efficient defensive methods, the real nature of which we but imperfectly understand, as for instance, the vaccinations against smallpox and hydrophobia. Although we are not yet able absolutely to prevent disease, we are able in many cases to restrict the communication of diseases and to modify their course in the individuals attacked.

The medicine of the future has, therefore to deal much more extensively than in the past with preventive medicine, or in other words, with the causes of disease as it attacks society, the community, or the state, rather than the individual. The object in view will be not only to arrest or modify a malady which has appeared in the body of a patient, but, as in the recent case of yellow fever, to learn how the disease is communicated and how to prevent that communication. The study of mitigations, remedies and cures is to continue; but the study of the causes of disease and the means of prevention is to be greatly developed. The function of the nineteenth-century physician will continue, and indeed will become more effective through a better knowledge of the forces which may be made to act upon his patient both from within and from without; but another sort of physician will be at work in the twentieth century preventing the access of epidemics, limiting them when they arrive, defending society against bad food and drink, and reducing to lowest terms the manifold evils which result from the congestion of population. The explorers and pioneers in medical science must be encouraged to press on their patient work of analyzing all the processes which accompany disease, in order that they may learn their actual sequences. Only through the knowledge of these sequences can real control over disease be certainly gained. And this

work will be endless; for civilization involves constant changes in the environment of the human race; and it is on medical science that the race must depend for protecting it from the new dangers which accompany each novel environment. The medical scientists being provided and furthered, medical education must also train large bodies of men to clear and cultivate the regions through which the pioneers have made trails, or, in plainer words, to apply to millions of men and women in all sorts of climate and environment the discoveries of the scientists. Thus thousands of physicians all over our southern states must for years be teaching the people how to protect themselves from yellow fever. Major Walter Reed and his colleagues proved how yellow fever is communicated, and—what was equally important—how it is not communicated; but thousands of medical men must see to it that intelligent application is made of that precious knowledge.

Recent events have brought into strong light a new function of the medical profession which is sure to be amplified and made more effective in the near future. I mean the function of teaching the whole population how diseases are caused and communicated, and what are the corresponding means of prevention. The recent campaign against tuberculosis is a good illustration of this new function of the profession. To discharge it well requires in medical men the power of interesting exposition, with telling illustration and moving exhortation. Obviously the function calls for disinterestedness and public spirit on the part of the profession; but to this call it is certain that the profession will respond. It also calls for some new adjustments and new functions in medical schools, which should hereafter be careful to provide means of popular exposition concerning water supplies, foods, drinks, drugs, the parasitic causes or consequences of disease in men, plants and animals, and the modes of communication of all communicable diseases. Medical museums should be arranged in part for the instruction of the public, and with some suitable reservations should be statedly open to the public. The medical schools should also habitually provide popular lectures on medical subjects, and these lectures should be given without charge on days and at hours when working people can attend. In other words, selected physicians should become public teachers, as well as private practitioners. America has much to learn from Europe in regard to this public-spirited service on the part of the profession.

In another respect the teaching of medicine must be broadened in the century we have now entered on. Medical study has been in time past far too exclusively the study of man's body by itself. Hereafter the study of medicine must be largely comparative, or in other words, must include man's relations to the animal and vegetable kingdoms. The Harvard Medical School enters into possession of its new buildings with three professorships of comparative medicine already established, the professorships of comparative anatomy, comparative physiology and comparative pathology. This tendency to comparative study has been already well developed in other subjects, as for example, in comparative psychology, legislation and religion. Wherever this study by comparison wins adequate place, it makes the study of the subject broader and more liberalizing, and the results obtained more comprehensive and juster. Medical students should, therefore, have studied zoology and botany before beginning the study of medicine, and should have acquired some skill in the use of the scalpel and the microscope. It is absurd that anybody should begin with the human

body the practise of dissection or of surgery; and, furthermore, it is wholly irrational that any young man who means to be a physician should not have mastered the elements of biology, chemistry and physics years before he enters a medical school. The mental constitution of the physician is essentially that of the naturalist; and the tastes and capacities of the naturalist reveal themselves, and, indeed, demand satisfaction long before twenty-one years of age, which is a good age for entering a medical school. The Harvard Medical School has derived great advantages from its requirement of a previous degree for admission; but in view of the fact that many young men procure a bachelor's degree without ever having studied any science, the school needs an additional and more specific requirement, namely, a previous knowledge of biology, physics and organic chemistry, and an acquaintance with laboratory methods in all three subjects.

As at the preliminary stages of the medical career, so at its climax there is an increasing need of men who have a working knowledge of several sciences which were formerly treated as distinct, and whose best representatives in medical schools labored apart each in his own field. The most promising medical research of our day makes use of biological, chemical and physical science combined. Physiology advances by making applications of the principles, the methods and the implements of all three sciences. The physiologist listens to the normal or abnormal sounds in the bodies of men and animals with a modified telephone, and may record by electricity almost all the phenomena he studies. Bacteriology and biological chemistry go hand in hand in serving pathology and the public health. A great number of new chemical substances, coming from organic sources, and yet as definite and uniform in composition as salt or alum, prove serviceable in pharmacology, and in physiological and pathological research, although they were neither discovered nor manufactured with any such purpose in view. The stainings of bacteriological technique, and the quantitative color tests for characteristic ingredients in the various secretions of the body, ingredients which fluctuate in amount in health or in disease, illustrate the present dependence of medical research on chemistry and physics. For the effective study of the toxins and antitoxins, within and without the body, the bacteriologist and the biological chemist must cooperate. Many of the effects produced by the toxins in the living body are definite chemical changes, such for instance as may be produced by the activation of certain ferments, and the antagonism of toxin and antitoxin is probably a chemical reaction. Many of the great discoveries of the future will come through the cooperation of sympathetic groups of medical scientists representing different modes of attacking the same problem. There will be a like necessity for cooperation between the clinician, the pathological anatomist, the physiological chemist and the bacteriologist.

The world has observed, and will not forget, that some of the greatest contributors to the progress of medicine and surgery during the past thirty years have been, not physicians, but naturalists and chemists. Pasteur was a chemist, Cohn, the teacher of Koch, a botanist, and Metchnikoff a zoologist. Students of disease must, therefore, be competent to utilize in their great task every aid which natural science can furnish. How vastly is the range of medical science and medical education broadened by this plain necessity! The dignity and serviceableness of the medical profession are heightened by every new

demand on the intelligence and devotion of its members.

The recent liberal endowment of the Harvard Medical School by private persons is an indication that the more intelligent and public-spirited portion of the American people is beginning to understand that most diseases would be preventable, if only mankind had acquired the knowledge needed to prevent them. The urgent duty of society to-day is to spend the money needed to get that knowledge. How to spend it we have learned—witness the admirable work of the Massachusetts Board of Health for thirty years past, aggressive work both defensive and offensive; witness also the remarkable results of the medical institutes both in this country and in Europe.

The medical profession of the future will have the satisfaction not only of ameliorating the condition or prolonging the life of the suffering individual, but also of exterminating or closely limiting the preventable diseases. CHARLES W. ELIOT.

THE UNITY OF THE MEDICAL SCIENCES.[1]

THE dedication of the new buildings of the Harvard Medical School is an occasion for rejoicing, not to Harvard University alone, but to all in this country and elsewhere interested in the progress of medical education and of medical science, and in behalf of all such I beg to offer to this university hearty congratulations upon this magnificent addition to its resources for medical teaching and study. Medicine everywhere and especially in America has reason to be profoundly grateful to the generous and public-spirited donors who have made possible the construction of this group of buildings, unsurpassed in the imposing beauty and harmony of their architectural design and in their ample, internal arrangements. This design is adapted from the Greek, and it is peculiarly fitting that the medical sciences should be housed in a style which suggests the spirit of ancient Greece, where first flowed the springs of medical science and art, living springs even to this day. In the singular harmony of the architecture of the group of buildings devoted to the various medical sciences are typified the unity of purpose of these sciences and their combination into the one great science of medicine. What I shall have to say on this occasion is suggested in part by this thought of the 'Unity of Medical Science.'

The good fortune of the Harvard Medical School in coming into possession of the splendid laboratories now formally dedicated is well merited by the leading position which this institution has held in this country since its foundation, by its union with Harvard University and by the assurance that the greatly enlarged opportunities will here be used to the highest advantage. Since the appointment in 1782 of its first professors, John Warren and Benjamin Waterhouse, of enduring fame, this school has had a long line of honored names upon its roll of teachers, lustrous not only for such single stars as Channing and Ware and Holmes and Ellis and Cheever, but especially for its clustered stars, the Warrens, the Jacksons, the Bigelows, the Shattucks, the Wymans, the Bowditchs, the Minots; and it will not be deemed invidious on this occasion to mention of the latter group the names of two members of the present distinguished faculty to whose services this school is so largely indebted for securing the funds for the new buildings, Professor Henry P. Bowditch, the eminent leader of American physiologists, and Professor John Collins

[1] An address delivered by William H. Welch, M.D., LL.D., professor of pathology, Johns Hopkins University, on September 26, 1906, at Harvard University, at the dedication of the new buildings of the Harvard Medical School.

Warren, who as surgeon, writer and teacher has so worthily maintained and enhanced the ancestral fame.

The Harvard Medical School has been a pioneer in this country in many improvements of medical education; it has stood successfully in an historic city and commonwealth for high standards of professional attainment and honor and for just recognition of the dignity and usefulness of the profession; it has made valuable contributions to the advancement of medical knowledge and practise, and above all there issued from this school and the Massachusetts General Hospital through John Collins Warren, the elder, and Samuel G. Morton medicine's supreme gift to suffering humanity of surgical anesthesia.

This school, however, has no possession so valuable or which gives such assurance of its stability and growth for untold generations to come and of the worthy bestowal of the great gifts which were dedicated yesterday as its union with Harvard University, and it is befitting that the significance of this university relationship should be emphasized by including among the dedicatory ceremonies this academic function in the halls of this great university.

The severance of the historical union of medical school and university, leading to the establishment of a multitude of independent medical schools without responsible control and usurping the right to confer the doctor's degree and the license to practise, is accountable in large measure for the low position to which medical education in this country sank during the larger part of the last century, and from which it has now risen in our better schools to a height which we can contemplate with increasing satisfaction. Nor would it be difficult to show, if this were the suitable occasion, that our universities on their side have suffered from the loss of a member which has brought renown to many foreign universities and that many of the embarrassing anomalies of our collegiate system of education are due to lack of personal contact, on the part of colleges and universities, with the needs of professional, especially medical, training. There is of course no saving grace in a merely nominal connection of medical school and university; the union to be of mutual benefit must be a real and vital one; ideals of the university must inspire the whole life and activities of the medical department.

To have recognized fully from the beginning of his administration the importance of this vitalizing union of the medical school with the university, to have striven patiently with full grasp of the problems and with intelligent sympathy with the needs of medicine for the uplifting of the standards of medical education, and, with the aid of his medical colleagues, to have planted these standards where they now are in the Harvard Medical School is not the least of the many enduring services which President Eliot has rendered to American education, and, in behalf of our profession, I wish to make to you, sir, on this occasion grateful acknowledgment of this great and beneficent work.

The opening of the new laboratories of the Harvard Medical School marks the culmination, up to the present time, of an educational and scientific movement which has been the most distinctive characteristic of the development of medicine during the past fifty years and which has transformed the face of modern medicine. To have some idea of the extent and the direction of this development consider how inconceivable would have been the mere existence of such laboratories a century ago, and how impossible it would have been

for even a Bichat or a Laënnec to have put them to any use or to have imagined their use. The only scientific laboratory which existed at that time was the anatomical, and this had been in existence for at least two hundred and fifty years, although not in a form which meets our present ideas of such a laboratory.

The modern scientific laboratory was born in Germany in 1824 when Purkinje established the first physiological laboratory, thus antedating by one year the foundation of Liebig's chemical laboratory, which had a much greater influence upon the subsequent development of laboratories. As might naturally be expected, anatomical and physiological laboratories had attained a considerable development before the first pathological laboratory was founded in Berlin by Virchow. The opening and activities of this laboratory, which has recently celebrated its fiftieth anniversary, mark an era in the progress of medicine. With the exception of the modest beginning of a pharmacological laboratory by Buchheim about 1850, all of the other medical laboratories—those of physiological chemistry, of hygiene, of bacteriology, of clinical medicine—originated at a much later date.

This remarkable growth of laboratories for the cultivation of the various medical sciences has been at once the cause and the result of the rapid progress of medicine in recent years. By teaching and exemplifying the only fruitful method of advancing natural knowledge laboratories have overthrown the dominance of authority and dogma and speculation and have turned medicine irrevocably into the paths of science, establishing the medical sciences as important departments of biology; by demonstrating that the only abiding, living knowledge, powerful for right action, comes from intimate, personal contact with the objects of study they have revolutionized the methods of medical teaching; by discovery they have widened the boundaries of old domains and opened to exploration entirely new fields of knowledge, by the application of which man's power over disease has been greatly increased.

Medicine, as a science, is occupied with the systematic study of the structures and functions of the human and animal body in health, of their changes by disease and injury, and of the agencies by which such morbid changes may be prevented, alleviated or removed. Its ultimate aim, which indicates also its method, is that of all science, the deduction of general concepts and laws from the comparison of the relationships and sequences of ascertained facts, and the application of these laws to the promotion of human welfare. This goal, to-day far from realization, is most nearly approached where the principles of physics and of chemistry can be applied, but there remains a large biological field awaiting reclamation for the application of these principles. The subject matter of medical study, as thus indicated, is of supreme import to mankind, but complex and difficult far beyond that of any other natural or physical science.

The places where such study may be most advantageously carried on are laboratories and hospitals supplied with the material for study, with the necessary instruments, appliances and books, and with trained workers. By growth of medical knowledge the field to be covered has become so vast as to require much subdivision of labor, nor is it to be supposed that the end of this subdivision has been even approximately reached.

From human anatomy, the mother of medical as well as of many other natural sciences, there branched off in the eighteenth century physiology, and, still later,

pathological anatomy. As if to replace these losses anatomy gave birth to comparative anatomy, embryology and microscopic anatomy as more or less separate branches.

During the past century physiological chemistry and pharmacology have separated from physiology, and comparative pathology and experimental pathological physiology are asserting their independence from pathological anatomy.

Hygiene and bacteriology are of recent and more independent growth. The latter, lusty stripling, with the rise of medical zoology, especially protozoology, is seeking a more comprehensive and appropriate designation. The latest and, perhaps, the most significant development is the clinical laboratory in its various forms.

Specialization in scientific work should not be decried; it is demanded by the necessities of the case and has been the great instrument of progress, but the further division of labor is carried, the more necessary does it become to emphasize essential unity of purpose and to secure coordination and cordial cooperation of allied sciences. Especially urgent is full recognition of the unity and cooperation of the clinic and the laboratory.

During the last two decades we have witnessed in this country the extraordinary rise of practical laboratory instruction from the weakest to the strongest and best organized part of the medical curriculum of our better schools. Our laboratory courses are, I believe, in several instances more elaborate and occupy more time than corresponding ones in most foreign universities.

As was emphasized by Dr. Dwight and Dr. Shattuck in their remarks yesterday, it is, however, an error to suppose that from the point of view of science any fundamental distinction exists between the clinical and the so-called laboratory subjects other than that based upon differences in the subject-matter of study. The problems of the living patient are just as capable of study by scientific methods and in the scientific spirit and they pertain to independent branches of medical science just as truly as those of anatomy, physiology or the other so-called laboratory subjects. All of the medical sciences are interdependent, but each has its own problems and methods, and each is most fruitfully cultivated for its own sake by those specially trained for the work.

There is a highly significant and hopeful scientific movement in internal medicine and surgery to-day characterized by the establishment of laboratories for clinical research, by the application of refined physical, chemical and biological methods to the problems of diagnosis and therapy, and by the scientific investigation along broad lines of the special problems furnished by the living patient. The most urgent need in medical education at the present time in this country I believe to be the organization of our clinics both for teaching and for research in the spirit of this modern movement and with provision for as intimate, prolonged, personal contact of the student with the subject of study as he finds in the laboratory.

In addition to undergraduate instruction our laboratories at present furnish better opportunities for the prolonged, advanced training of those intending to make their careers in anatomy, physiology, pathology and other sciences, than are afforded by most of our hospitals to those who aim at the higher careers in medicine and surgery. A further clinical disadvantage is that while the former class after good scientific work may reasonably look forward to desirable positions as teachers and directors of laboratories, the latter,

however high their attainments, in consequence of the separation of the medical school from any control over the appointments to the hospital staff, can not anticipate with any degree of assurance similar promotion in their chosen lines of work, and consequently the medical faculty has not so wide a field of choice in filling the clinical chairs as in filling those of the auxiliary sciences.

The removal of these deficiencies on the clinical side of medical education in America requires some reorganization of its staff on the part of the hospital and the control by the medical school of its hospital, or, at least its voice in appointments to the hospital staff. So far as our resources permit, we have, I think, accomplished this reform at the Johns Hopkins Medical School and Hospital.

The welfare of the patient is the first obligation of the trustees of hospitals and of physicians in attendance, but nothing is more certain than that cordial cooperation between medical school and hospital best subserves the promotion of this welfare. Fortunate the hospital and fortunate the patients brought into such relations with the Harvard Medical School.

As is strikingly illustrated by the new buildings of this school, the educational machinery of medicine to-day is vastly complicated and costly compared with the simplicity of the days when a lecture room, a dissecting room, a simple chemical laboratory and a clinical amphitheater were all that was needed. The purpose of medical education, however, remains to-day what it has always been and will continue to be —the training of the student for the future practise of his profession, and to this end in a harmonious scheme of education the various medical sciences all work together. Right action requires abundant knowledge, nowhere more so than in medical practise, and the all-sufficient justification for the position held by the various sciences in the preliminary and the professional education of the physician is that they furnish knowledge and discipline of mind needed in the preparation for his future work. The social position of the medical man and his influence in the community depend to a considerable extent upon his preliminary education and general culture. For this reason as well as for his intellectual pleasure in his profession and as a sound foundation for his future studies the student should enter the medical school with a liberal education, which should include training in the sciences fundamental to medicine.

The unity of the various medical sciences is manifested not only in their historical development and in their cooperation in the scheme of medical education, but especially in their contributions to the upbuilding and progress of medicine as a whole.

There is no branch of medicine or even of physical science which has not played an important part in the evolution of our present medical knowledge and beliefs. The great lesson taught by the history of this development of medicine through the centuries has been the unconditional reverence for facts revealed by observation, experiment and just inference as contrasted with the sterility of mere speculation and reliance upon transmitted authority. The great epochs of this history have been characterized by some great discovery, by the introduction of some new method, or by the appearance of some man of genius to push investigation and scientific inference to limits not attainable by ordinary minds. The history of medicine has a greater unity and continuity and extends over a longer period of time than that of any other science.

The first clear note, which has rung down the ages, was sounded by Hippocrates when he taught the value of the inductive method by simple, objective study of the symptoms of disease, and the cry 'Back to Hippocrates' has more than once recalled medicine from dogmas and systems into sane and rational paths. Medicine, however, was handed on from the Greeks and Romans in bondage to a system of doctrine, constructed by Galen, so completely satisfying to the medieval mind that this system remained practically untouched for over a thousand years.

With the liberation of intellect through the renaissance came the great emancipators, in the sixteenth century, Vesalius and, in the seventeenth, Harvey, the former placing human anatomy upon a firm foundation and bringing medicine into touch with the most solid basis of fact in its domain, the latter bringing to light in the demonstration of the circulation of the blood the central fact of physiology and applying for the first time in a large and fruitful way to medicine the most powerful lever of scientific advance, the method of experiment.

In the century of Galileo, Harvey and Newton instruments of precision as the chronometer, the thermometer, the balance, the microscope, were first applied to the investigation of medical problems, and physics began to render those services to medicine which, continued from Galileo to Röntgen, have been of simply incalculable value. The debt of medicine to chemistry began even with the rise of alchemy, received an immense increment from the researches of Lavoisier, the founder of modern chemistry, concerning the function of respiration and the sources of animal heat, and has grown unceasingly and to enormous proportions up to these days of physical chemistry, which has found such important applications in physiology and pathology.

How disastrous may be to medicine the loss of the sense of unity in all its branches has been very clearly and admirably shown by Professor Allbutt in depicting the effects which for centuries followed the casting off from medicine of surgery as a subject unworthy the attention of the medical faculty. Thereby internal medicine lost touch with reality and the inductive method, and remained sterile and fantastic until the days of Harvey, Sydenham and Boerhaave. The services of surgery to medicine as a whole, so brilliantly exemplified in the experimental work of John Hunter in the eighteenth century, have become a distinguishing feature of the medicine of the present day.

The great awakening of clinical medicine came in the early part of the nineteenth century from the introduction of the new methods of physical diagnosis by Laënnec and from pathological anatomy. The subsequent development of scientific and practical medicine has far exceeded that of all the preceding centuries. It has kept pace with the progress during the same wonderful century of all the sciences of nature and has contributed even more to the promotion of human happiness.

In anatomy with embryology and histology, in physiology, pathology, physiological chemistry, pharmacology, hygiene, bacteriology—sciences which are ancillary to medicine and at the same time important branches of biological science—there have been marvellous activity and expansion. For physiology and the understanding of disease the establishment of the cell doctrine by the aid of botany, embryology and pathology has been the greatest achievement. By the combined aid of physiology, physiological chemistry, experimental pathology, improved methods

of diagnosis and clinical study, medicine has gained new and higher points of view in passing from too exclusive emphasis upon the final stages of disease revealed by morbid anatomy to clearer conceptions of the beginning and progress of morbid processes as indicated by disturbances of function, and above all has penetrated to the knowledge of the causation of an important class of diseases, the infectious. As a result of this rapid growth of knowledge in many directions has come a great increase in the physician's power to do good by the relief of suffering and the prevention and cure of disease.

In this connection I wish especially to emphasize the mutual helpfulness of the various medical sciences in the development of medical knowledge and practise. Attention is generally so concentrated upon the final achievement that there is danger of losing sight of the manifold sources which have contributed to the result. Let my medical hearers consider, for example, the indispensable share of embryology, of anatomy, gross and microscopic, of physiology, of pathological anatomy, of clinical study in the evolution of our knowledge of the latest contribution to diseases of the circulatory system—that disturbance of the cardiac rhythm called 'heart-block.' Similar illustrations of the unity of the medical sciences and of the cooperation of the laboratory and the clinic might be multiplied indefinitely from all classes of disease.

The same phenomenon is exhibited in medicine as in all science that the search for knowledge with exclusive reference to its practical application is generally unrewarded. The student of nature must find his satisfaction in search for the truth and in the consciousness that he has contributed something to the fund of knowledge on which reposes man's dominion over reluctant matter and inexorable forces.

How readily better action attends upon increased knowledge is shown by the part which the art of medicine is playing and is destined to play even more prominently in the world's progress. The value of this work of modern medicine is to be measured in part, but only in part, by the standard applied by the average man, namely, improvement, which, indeed, has been great, in the treatment of disease and injury. It is, however, its increasing power to check the incalculable waste of life, of energy, of money from preventable disease that places medicine to-day in the front rank of forces for the advancement of civilization and the improvement of human society. Economists and other students of social conditions have begun to realize this, but governments and the people are not half awake, and medicine, shaking off all mystery, and with a sense of high public duty, has before it a great campaign of popular education.

The knowledge which has placed preventive medicine upon a sound basis and has given it the power to restrain and in some instances even to exterminate such diseases as cholera, plague, yellow fever, malaria, typhoid fever, tuberculosis and other infections has come from exploration of the fields opened by Pasteur and by Koch. This power and the certainty of increasing it have given great strength to appeals for the endowment of medical research and the construction of laboratories. What is all the money ever expended for medical education and medical science compared with the one gift to humanity of Walter Reed and his colleagues of the army commission—the power to rid the world of yellow fever?

Great as has been the advance of medicine in the past half century, it is small

indeed in comparison with what remains to be accomplished. Only a corner of the veil has been lifted. On every hand there are still unsolved problems of disease of overshadowing importance. The ultimate problems relate to the nature and fundamental properties of living matter, and the power to modify these properties in desired directions. Here we are far from the satisfactory *pou sto*. But knowledge breeds new knowledge, and we can not doubt that research will be even more productive in the future than it has been in the past. It would be hazardous in the extreme to attempt to predict the particular direction of future discovery. How unpredictable even to the most far-sighted of a past generation would have been such discoveries as the principles of antiseptic surgery, antitoxins, bacterial vaccines, opsonins, the extermination of yellow fever or malaria by destruction of a particular species of mosquito and many other recent contributions to medical knowledge.

The activities within the new buildings of the Harvard Medical School begin at a period of medical development full of present interest and full of hope for the future, and it may be confidently predicted that they will have an important share in the onward movement, educational and scientific, of medicine.

One side of these activities will be devoted, under conditions most admirable as regards teachers, methods and opportunities, to the training of medical students and to advanced instruction. Supplemented by similar opportunities for undergraduate and advanced training in the hospital wards and dispensary these conditions will be ideal.

The inspection of these noble new buildings, however, shows clearly that those who have planned them with such care, foresight and sagacity, while recognizing fully their important educational uses, have had also another and a main thought in their arrangements, namely, their adaptation to the purposes of original research. It is this dual function of imparting and of advancing knowledge which justifies the expenditure of money and which insures a return of the capital invested in buildings, equipment and operation with a high rate of interest in the form of benefits to mankind.

The most ample and freely available facilities are an important condition for productive research, but on this creative side of university work men count for more than stately edifice and all the pride and pomp of outward life. Research is not to be bought in the market place, nor does it follow the commercial law of supply and demand. The multitude can acquire knowledge; many there are who can impart it skilfully; smaller, but still considerable is the number of those who can add new facts to the store of knowledge, but rare indeed are the thinkers, born with the genius for discovery and with the gift of the scientific imagination to interpret in broad generalizations and laws the phenomena of nature. These last are the glory of a university. Search for them far and wide beyond college gate and city wall, and when found cherish them as a possession beyond all price.

By the possession of investigators such as these, by the character and work of teachers and taught, by the advancement of knowledge and improvement of practise, may this new home of the Harvard Medical School, be a center for the diffusion of truth in medicine, the abode of productive research, a fortress in the warfare against disease, and thereby dedicated to the service of humanity.

WILLIAM H. WELCH.

SCIENTIFIC BOOKS.

Geology. By T. C. Chamberlin and R. D. Salisbury. 3 vols. 8vo, illustrated. New York, Henry Holt & Co. Vol. I. *Geologic Processes and their Results.* Pp. xix + 654. 1904. Vol. II. *Earth History (Genesis-Paleozoic).* Pp. xxvii + 692. 1906. Vol. III. *Earth History (Mesozoic, Cenozoic).* Pp. xi + 624. 1906.

The appearance of this monumental work is an event of more than ordinary importance in the history of geologic book-making. The authors are men of great and varied experience in field geology in different parts of the world, and they are thoroughly skilled in handling the more abstruse problems of speculative geology. They are also too serious-minded and too actively engaged in geologic research to give their time to the preparation of a text-book or manual of geology of the ordinary type. The geologists of the country and of the world, therefore, feel that they have a right to expect in these three volumes to find geology not only brought well up to date in all its branches, but new fields pointed out for future activity, research and philosophic deduction.

But if such a work should fully meet all of the hopes and expectations of all geologists it would have to be more than human. No man and no two men can publish a text-book of 2,027 pages on geology without omitting many things that some of us think ought to have gone in, and without putting in much that some of us think ought to have been left out. In these days of specialization, too, the help of many specialists must be had in the preparation of such a book, and even the specialist is often a little behind one or another colleague regarding details of some importance in his own specialty. Aside from the matter of scientific import, the mere mechanical preparation and editing of such a book is a task of no small responsibility. But none the less authors of books that are to be taken seriously must expect to have their work scrutinized with a closeness and minuteness proportionate to the seriousness of their undertaking.

One of the most useful features of a good manual for advanced students, such as this work claims to be, is its reference to geologic literature. Two of the best manuals in the English language stand in strong contrast to each other in this respect: Dana's manual, hitherto our best American work, is notably lacking in foot-note references, while Geikie's text-book has abundant and discriminating references to the literature of every subject treated. The first two volumes of Chamberlin and Salisbury have entirely too few references to the literature of geology, and of these, too many are to text-books instead of the original sources, and where original sources are mentioned the references are sometimes not up to date. This sort of thing is allowable in elementary works, but hardly so in one of these dimensions.

The geographic part of the first volume is beautifully illustrated with colored topographic plates, a happy and thoroughly effective method of showing certain geographic features, but these plates are not accompanied by explanations, nor do they contain references to places in the text where they are explained. The text itself refers here and there to the plates, but one gets tired of hunting for plates and counting them and looking for their numbers in an effort to follow the text intelligently. Some of these plates might have been much improved by striking out certain lines from the originals. On plate XVI. (opposite p. 179, Vol. I.), for example, the heavy broken black line down the middle of the Missouri River might better have been omitted. There are but few of these otherwise beautiful illustrations that are not marred by these heavy black political boundary lines.

The language is sometimes obscure. We are no sticklers for making everything easy for the student, but we do believe in making it simple when it may as well be simple as complex and difficult to follow. Students need to give their time to thinking about the subject on hand instead of wondering what a writer is driving at. For example, at p. 265 of Vol. I., it is said that 'this dynamic source of heat may modify the theoretical deductions

drawn above from the atmospheric and internal influences.' On p. 338 it is said of waves normal to the shore that 'the advance and recoil of the water move particles toward and from the shore, but effect no transfer in the direction of the shore,' probably meaning along the shore. Again at p. 429 it is said: 'If the heat factor in metamorphism be sufficiently increased, aqueous solution may actually grade into magmatic solution through various degrees of softening and melting, and the cycle of changes be closed in upon itself.

Personally, we do not think well of the frequent personification of natural objects. For example, streams are spoken of in Vol. I. as if they had designs: they are said to struggle (p. 95), to steal (p. 98), to commit piracy, to drop out of the race (p. 96), to refuse to remain (p. 169), to have feeding grounds (p. 516), senility and death (p. 85); a lava stream chooses its direction (p. 580), and in one place a volcano is said to be 'enjoying its customary period of rest' (p. 571). This sort of language is as much out of place in geology as it would be in chemistry or physics.

While some subjects are treated with great fullness others are passed over with next to no attention. The theory of isostacy, for example, is barely mentioned twice, while the process and importance of flocculation in the deposition of finely divided sediments is only referred to on p. 360 of Vol. I. as a limited and obscure action. A brief bibliography of the subject of flocculation is given in *Nature*, LXIV., 279, and some of its obscurity has been removed by Joly and others there mentioned.

The general subject of coral reefs is dismissed (I., 630) with the remark that, 'The contribution of coral polyps to the formation of limestone is most important, and is too familiar to require elaboration here.' Most of us who think that corals form only dolomites and dolomitic limestones can not be expected to accept this dismissal of the subject as a fair disposal of it, especially in view of the promise made on p. v of the introduction to Vol. I., where it is stated that 'Antecedent elementary courses in geology will not be necessary to the use of these volumes.'

There are many oversights that must annoy teachers of geology, especially in view of the fact that students, as every teacher knows, are so much disposed to regard text-books and statements in print as infallible. The following are some of the statements in Vol. I. that do not seem to be altogether above question or require modification or explanation: on page 501 it is said that 'faults rarely show themselves in the topography of the surface.' A California geologist could hardly be expected to support such a statement with a straight face. On p. 150, figure 146, a syncline is called an anticline. On p. 170 the decrease in the volume of a stream is explained in every way except the one in which we most frequently see it decreased, namely, the run-off of flood waters. It is said on p. 184 that theoretically the rotation of the earth should increase erosion on 'the right bank of streams in the northern hemisphere and the left in the southern,' when no reference is made to the direction of the streams. On p. 188 mention is made of 'the load except that in suspension,' when solution seems to be meant. The branching of streams amidst their delta deposits is explained (p. 189) by water breaking over side-levees. Some branches may possibly be so formed, but this explanation can not be accepted for the main divisions of the Mississippi at its mouth. In explaining river terraces (p. 198) no mention is made of a stream swinging back and forth across a flood plain in which it is cutting a channel. It is stated (p. 213) that the deposition of mineral matter from boiling water is the same process as that by which it is deposited upon evaporation: we have not been accustomed to think so. In listing the factors of deposition from solution no mention is made (p. 214) of either increase of temperature (with the carbonates), or of the escape of gases, such as carbon dioxide, from waters disturbed at waterfalls. On p. 218 natural bridges are called 'unique features.' The statements on p. 277 lead one to suppose that fiords are only made by glaciers.

The depression of the island of Hawaii would produce remarkably fine fiords.

In explaining the movements of sea water (p. 319) no mention is made of the lagging of waters moving over a revolving globe. On the same page the difference in densities of sea water is said to be due to differences in temperature and salinity, as if salt were the only mineral in solution in sea water. On p. 478 it is said that a dip of 40° S. 20° W. is the same as dip 40° strike W. 20° N. It may be the same, but it may also be N. 20° E., that is, in exactly the opposite direction. Moreover, it is customary to read the compass from the N. or S. end, not from E. or W. In Fig. 399 on p. 482 the strike should, therefore, read N. 80° E., instead of E. 10° N. The figure seems to be intended for a note-book record, but unless placed on a map it would be useless, for no direction is given for the dip. The writer's experience shows that dips indicated by arrows never mislead, while dips shown by plain lines (pp. 482–4) require an effort of the memory on the part of the student.

It is suggested (p. 507) that earthquakes cause the great waves that sometimes accompany shocks by thrusting their 'waters off shore by their sudden impact.' The late California earthquake was certainly violent enough to have given us an example of this kind of a wave if such a thing had been possible.

On p. 615 is 'the inference that a vegetal covering of the land extended as far back in the history of the earth as clay shales, quartz-one sandstones and limestones form the prevailing sediments.' The reasons for this inference are not clear. Long ago Daubrée demonstrated that feldspars mechanically ground up in the presence of water become kaolinized; this process would account for clay shales without the intervention of organic acids to decompose feldspathic rocks. Neither is it clear how land plants are indispensable to the formation of limestones. The carbon dioxide of waters is derived partly from the atmosphere. Lime carried to the sea by waters so carbonated would contribute to lime-secreting organisms, and limestone would thus be formed without the intervention of land plants.

The examples of deposits of diatoms (I., 625) might well include some of the great deposits such as those of the Santa Cruz Mountains of California, where they are five thousand feet thick.

In regard to the meteorite figured in Vol. II., p. 24, after Liversidge (not Liveridge) we venture to suggest the possibility of its having been artificially shaped. Its size and form appear to lend support to this idea. The authors do not say where it is described, but the original paper is in the *Jour.* and *Proc. Roy. Soc. of N. S. W.*, Vol. 36, p. 341. The description of the finding seems to preclude the possibility of its artificial origin, but experience shows that the stories associated with the finding of such things often require close scrutiny. The form of this meteorite is too unusual to be accepted without question.

In Vol. II., p. 653, the advent of the Ammonites is spoken of as occurring in the Permian. It was shown several years ago that the Ammonites were abundant in the Coal Measures (Mon. XLII., U. S. G. S., 22–28, Washington, 1903). In Vol. III. but little attention is paid to the stratigraphy of the west coast, and one might infer that the standard sections of the Mesozoic and Cenozoic were all in the eastern part of the United States. As a matter of fact, the finest sections of the Trias, Jura, Cretaceous, Miocene, Pliocene and marine Quaternary in North America are found on the west coast. One would also be led to infer from the illustrations that only land life was known in the Pleistocene of the United States, whereas marine life is certainly of equal importance and has been fully described.

The discussions that stand forth prominently in the entire work on account of their far-reaching importance and on account of the care, seriousness and comprehensiveness with which they are discussed are: (1) the planetesimal hypothesis of the origin of the earth; (2) the origin of the atmosphere; (3) the origin of the ocean; (4) of volcanic phenomena; (5) of the hydrocarbons; (6) of life.

Although most of the theories formally set forth in the book have now been before geologists for several years (always from these same authors), it can not be said that these theories have as yet met with general acceptance either in this country or among the geologists of other countries. They must, therefore, be regarded as still on trial in a sense. None the less, these volumes are an epoch-marking work, and the theories set forth in them must be reckoned with hereafter in every book on geology and by every teacher and every student. In spite of its two thousand pages one feels that the matter is much condensed, and the authors impress the reader with their judicial attitude of mind, with their mastery of the subjects treated, and reserve force in their statements and discussions. Working geologists the world over owe the authors something too for their having spared us another new terminology or a new system of spelling. They seem to stand godfathers only to the new petrographic nomenclature given in abstract on pages 433–8 of Vol. I.

The illustrations, especially the half-tones, are abundant, excellent, and new to our text-books, though the line drawings are hardly up to the standard of the rest of the book. The work of the book manufacturer leads us to hope that the day is not far distant when publishers will find some way of making an illustrated octavo volume of six hundred pages without its weighing close to four pounds.

The principal adverse criticisms that can be made relate to the minor details of editing —not to the subject-matter or to the method of treatment. In the presence of so much that is large, and helpful, and inspiring such criticisms seem like mere quibbling. Not a subject is touched upon in the entire work that does not have the breath of a new life breathed into it.

J. C. BRANNER.

The Eye, its Refraction and Diseases: Diseases of and Operations upon the Eyeball and its Adnexa. By EDWARD E. GIBBONS, M.D., Assistant Surgeon to the Presbyterian Eye, Ear and Throat Hospital; Demonstrator and Chief of Clinic of Eye and Ear Diseases in the University of Maryland, Baltimore. Vol. II., pp. viii + 632. New York, The Macmillan Co. 1905.

Medical text-books may be classified according to their size or according to their character. The criterion of bulk is not necessarily a high one, but if a book is made of two large volumes it must be taken seriously and permitted to enter the lists with certain approved productions of well-known teachers.

There are a few text-books that stand out preeminently with a distinct individuality, in which the author shows that he has the matter or the method to justify the book's existence. Other books owe their lives to the patronage of growing groups of students, who feel in the printed lines the personality of the teacher to whom they have listened. This class does not always appeal to the larger public, and unless the teacher is of wide and rare experience it is apt to be uneven and to consist in part of a somewhat undigested collection of statements from unproved sources. This is unfortunately the impression made by the work under consideration. The first volume, which has been reviewed in these columns, was a book of more value because the author wrote with authority. Physiological optics and its application to the refraction of the eye was evidently a familiar field, and the book was welcome because there are very few writers in our language who can treat this difficult subject clearly and interestingly. This volume deals with the diseases of the eye and shows industry and a wide acquaintance with current literature. No author can be familiar with all the methods of treating disease in these prolific times, and an open mind is justified, but it may be misleading to the student, to group methods not sufficiently tried with those of proved value, without giving marked prominence to the latter.

A few positive criticisms must be made, however thankless the task. The important subject of localization of foreign bodies in the eye is insufficiently treated. There is no allusion to the frequent association between ocular disorder and disease of the nose and neighboring sinuses, and this is the more surprising

since to the less important association of eye and ear an entire chapter is given. The consideration of migraine and hysteria leaves much to be desired. The colored pictures of the fundus are rather sketchy. The index is not as complete as it should be to permit rapid reference, nor is the paragraphing well marked. The work of the publisher is excellent as regards paper and type. The unusual breadth of page gives a sense of solidity to the text which is hardly restful.

In spite of these faults and certain minor errors in the spelling of proper names, the book is a creditable one and with its very excellent companion volume will no doubt prove a useful addition to medical literature.

Colman W. Cutler.

New York City.

SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of Comparative Neurology and Psychology for September is devoted almost entirely to psychological papers. Mr. Charles Scott Berry first gives the results of an investigation of 'The Imitative Tendency of White Rats,' made at the Harvard Psychological Laboratory. One animal was taught various tricks alone and then observations were made to determine how far others would learn the tricks from him by imitation. He concludes that voluntary imitation (Morgan's usage) of a certain type does exist in white rats; and though this is not of as high degree as that discovered by Kinnaman in his experiments with monkeys, it is not different in kind. The next two papers are fragments selected from a large mass of MSS. by the late C. L. Herrick left unfinished at the time of his death. In 'Applications of Dynamic Theory to Physiological Problems,' Dr. Herrick applied in a concrete way to the problems of heredity and vitalism the conception of 'dynamic monism' which he had begun to develop in the philosophical journals. This is followed by a brief note on 'Imitation and Volition,' suggested by one of Professor Mark Baldwin's discussions. In the editorial column, under the title, 'Objective Nomenclature, Comparative Psychology and Animal Behavior,' Dr. Yerkes critically reviews the work of the objective school, and the methodological problems involved are discussed from a somewhat different standpoint by Dr. Bawden. Book reviews complete the number.

The Journal of Nervous and Mental Disease for October opens with an article by Drs. Mills and Weisenburg presenting the following propositions: (1) that the cortical representation of cutaneous and muscular sensibility is independent of motor representation, that it surrounds the motor zone; and that it is subdivided into a mosaic of centers, each center or group of centers being anatomically and functionally correlated to a motor center or centers; (2) that every muscle or group of muscles producing a movement or movements which are represented by separate centers in the cortex is topographically related to a segment of the skin which has also a definite cortical center, this center being correlated anatomically and functionally with the motor center; (3) that stereognostic representation like that of cutaneous and muscular sensibility and of movements has also its independent cortical area and is subdivided after the manner of the motor and sensory areas. This is followed by a continuation of a paper by Dr. Amberg, begun in the September issue, giving the histories of a number of cases of ear affections and mental disturbances.

DISCUSSION AND CORRESPONDENCE.

ON THE DOPPLER EFFECT.

In a recent number of Science (Vol. XXIV., p. 250) there appeared an article by Dr. Paul R. Heyl suggesting a plan for increasing the Doppler effect by observing a rapidly moving image instead of a moving source, the motion being magnified by placing the source just outside of the focus of a converging mirror. If, however, we consider that the wave-length of the separate rays (or, if preferred, of the elementary pencils) is independent of their point of intersection—in other words, of the position of the image—it appears that the only modification of wave-length observed in an instrument at rest relatively to the mirror will be due to the motion

of the source, and will be the same as if that were viewed directly. In other words, the change of wave-length depends on the *rate of change of optical path* from the source to the receiving apparatus. If the source is stationary and the mirror moved the effect is doubled whether the mirror is plane or curved.

The fallacy in Dr. Heyl's suggestion appears to lie in his considering a moving image as in all respects equivalent to a moving source. While this may be true as a proposition in geometrical optics, there is the essential physical distinction that the phase of the vibrations issuing from an image depends not only on the vibrations of the original source, but also upon the (optical) distance from that source. Doubtless if we were to follow the image with our spectroscope we should observe a change of wave-length due to the latter cause. However, even if we could surpass the feat of hitching our wagon to a star by hitching our instruments to the much more swiftly flying image, we should again have the same effect as if the source were viewed directly.

HORACE CLARK RICHARDS.
RANDAL MORGAN LABORATORY OF PHYSICS,
UNIVERSITY OF PENNSYLVANIA.

SPECIAL ARTICLES.

GLACIAL STAGES IN SOUTHEASTERN NEW ENGLAND AND VICINITY.[1]

FOR some years the writer has been engaged on the problem of the differentiation of the Pleistocene deposits of Long Island and southeastern New England. Some of the results have already been published,[2] and reports discussing in greater detail the subdivisions recognized, and their correlation are in preparation. The completion of the reports, however, owing to the assignment of the writer to other lines of investigation, is likely to be considerably delayed, and it has, therefore, seemed advisable to present a brief statement of the Pleistocene succession in the region in question, as it is understood by the writer, in the columns of this journal.

Pleistocene Subdivisions.

In the area examined, which includes Long Island, Gardiner's Island and Fisher's Island, New York; Block Island and the coast of Rhode Island, and Martha's Vineyard, Nantucket, Cape Cod and the coast of Massachusetts northward to Boston, the Pleistocene events appear to have been as follows:

1. *Deposition of the Deeply Oxidized Tills and Weathered Gravels.*—At Brockton and Stoughton, in Massachusetts, and other points in the vicinity, there are several exposures of bright yellow or red till composed of the disintegrated remains of local rocks occurring in protected spots beneath the younger tills. In most cases these old tills rest on deeply weathered rock surfaces, and are believed to represent preglacial residual soils slightly reworked by the first ice advance, which appears to be pre-Kansan in age.

On Long Island the Cretaceous is overlain unconformably by several hundred feet of yellow-stained gravel containing a few deeply weathered or disintegrated granitic pebbles and an occasional erratic crystalline boulder. It was originally correlated with a part of the Pensauken of New Jersey, but was later given the name Mannetto by Veatch. It is believed to be pre-Kansan and to represent the outwash of the same glacier which further inland deposited the till described in the preceding paragraph.

2. *Long Period of Subareal Erosion.*

3. *Deposition of Granitic Gravels.*—These gravels were noted in 1903 by Veatch in the well borings of western Long Island, and in the following year were recognized by the writer in the cliffs of Block Island, Martha's Vineyard and Cape Cod. They have a maximum thickness of 100 or more feet and consist of

[1] Published by permission of the director of the United States Geological Survey.

[2] 'Probable Representatives of the Pre-Wisconsin Till in Southeastern Massachusetts,' *Jour. Geol.*, Vol. 9, 1906, pp. 311–329. 'Probable Pre-Kansan and Iowan Deposits of Long Island, New York,' *Am. Geol.*, Vol. 32, 1903, pp. 308–312. 'Geology of Fishers Island, New York,' *Bull. Geol. Soc. Am.*, Vol. 16, 1905, pp. 367–390. 'Clays of Cape Cod,' Bull. 285, U. S. Geol. Survey, 1906, pp. 432–441.

quartz and granitic pebbles, the latter being especially numerous in the borings of western Long Island, where the deposit seems to approach a till in character. Elsewhere the formation is often sandy and is to be regarded as an outwash from the second, probably the Kansan, glacier. The formation is known as the Jameco.

4. *Deposition of Red and Black Clays.*—These clays, known as the Gardiner, overlie the Jameco with an abrupt line of demarcation on Long Island, Fisher's Island and Block Island, and on Martha's Vineyard, Cape Cod and the Massachusetts coast to Boston. They carry a shell fauna, characteristic of a somewhat colder climate than at present. The maximum thickness is about 100 feet. In some places the clay occurs as a single bed, while at other localities it is split up into a series of clays interbedded with sands. The color varies from red, through gray and brown, to black. It is correlated tentatively with the Yarmouth interglacial deposits of the central states.

5. *Deposition of Fine Sand.*—Following the Gardiner clay a thickness of ten to thirty feet of fine sand, often almost quartz flour, was deposited. This has been designated the Jacob sand and is regarded as a transition between the Gardiner clay and the Herod gravel. It is the equivalent in part of the Sankaty beds of Nantucket, in which locality it is abundantly fossiliferous.

6. *Deposition of Granitic Gravels.*—These gravels, known as the Herod, reach a maximum thickness of 100 feet or more, and consist of layers of quartz and granitic pebbles alternating with beds of sand. They are thought to mark the beginning of a third ice invasion, possibly the Illinoisan. They occur at nearly all points from Long Island to Boston, at which locality they have been recognized beneath the till of the drumlins.

7. *Deposition of the Principal Till of New England and Erosion by Ice.*—This till, which on Long Island and Fisher's Island and Cape Cod has been called the Montauk drift, is a hard, compact, dark gray, often partly cemented till, having a maximum thickness of perhaps 75 feet on Long Island, but reaching more than double this thickness in the drumlins about Boston, which, with few, if any, exceptions, belong to this stage. It is usually oxidized to a depth of ten to twenty feet and is regarded as probably Illinoisan in age. In places the ice by which it was deposited cut deeply into the underlying formations, and the till may rest directly upon any of the older deposits. In such instances the drift often departs widely from its normal character, partaking of the nature of the local beds from which its materials were derived. It marks an actual invasion of the ice.

8. *Deposition of Granitic Gravels.*—These gravels, together with their included beds of sand and an occasional layer of brownish clay, resemble the Jameco and Herod formations and are regarded as marking the close of the third, probably the Illinoisan, stage. They may be seen at many points on Long Island and between that island and Cape Cod.

9. *Great Erosion Interval: Possible Deposition of Clay.*—Clays have been recognized above the Montauk drift in the vicinity of Plymouth, and appear to overlie the drumlins near Boston. These underlie the latest drift and may possibly belong to the Iowan stage. It may be said, however, that in the region south of Boston but little reliable evidence has yet been obtained of the existence of drift of this stage, although it is not improbable that it may be present. Deposition, at the best, appears to have been a minor feature in the interval between the gravels last mentioned and the latest till, the interval being characterized rather by extensive erosion, such as might be expected to mark a long period like the Sangamon-Iowan-Peorian interval rather than the Peorian interval alone, in which, judging from the evidences in the central United States, relatively little erosion was accomplished.

10. *Deposition of Thin Till.*—This till is usually from two to twenty feet in thickness and is ordinarily loose and bouldery rather than clayey, and is oxidized to a depth of only two to five feet. It constitutes the surface deposit over most of southeastern Massachu-

setts, but, because of its thinness, has not heretofore been separated from the main or drumlin drift (Montauk) and has even failed of recognition where present on the extensive sandy deposits of the Plymouth and Cape Cod regions of Massachusetts. On Long Island it is better developed and is everywhere recognized above the older gravels. It is presumably to be correlated with the latest drift of the Mississippi Valley—the Wisconsin.

M. L. FULLER.
UNITED STATES GEOLOGICAL SURVEY.

FOOD HABITS OF THE SNAIL BULIMULUS DORMANI BINNEY.

THE orange and other *Citrus* species, several ornamentals, and various greenhouse and other plants are often badly disfigured by the presence of a black saprophytic fungus,[1] *Meliola Camelliæ* (Catt.) Sacc. commonly known in the orange-growing region of Florida as the 'sooty mold' of the orange. The fungus feeds on a sweet honey dew exuded by various insects, especially species of Aphidæ, Coccidæ and Aleyrodidæ. The habits of the Aleyrodidæ species are very favorable to the growth of the fungus. This is especially true of the so-called 'white fly' of the orange, *Aleyrodes citri*. The larvæ of this species, attaching themselves to the under surface of the leaves, exude honey dew which, falling to the top surface of the leaves and stems beneath supplies nourishment for a heavy growth of the fungus. The white fly and the fungus are invariably associated, and a badly infested grove or hedge may be recognized at some distance by its heavily coated dark foliage. So dense is the covering of the intertwining hyphæ that the smothering layer is believed to interfere seriously with the healthy action of the sunlight on the leaves. The fruit as well as the leaves and stems is coated, and a thorough washing of the smutty oranges becomes necessary before marketing; an added expense is thereby incurred as well as increased danger of bruising from additional handling and washing, and, unless the oranges are quickly and properly dried, of decay in shipping from the wetting. The presence of the sooty mold is thus one of the most serious results of white fly infection of orange groves, and almost the only appreciable injury from this species to privet and other ornamentals, and is an important element in the injury to various plants from numerous other sucking insects.

The habits of the snail *Bulimulus Dormani* Binney[2] are of the greatest interest in this connection. This species, the normal food of which is apparently fungi, algæ and perhaps lichens, has been found during the summer of 1905 in numerous groves in Manatee County feeding on the sooty mold. The trees on which the snails are found stand out conspicuously among the surrounding trees by their bright foliage and fruit, and clean trunks, in contrast to the sooty leaves and fruit of the surrounding trees. The work of the snails on orange trees is well seen in the Willis grove of the Manatee Lemon Company near Palmetto, Florida. The trees of this grove are seedlings and reach a height of thirty to thirty-five feet. Snails are present on perhaps seventy-five trees and have completely overrun them from top to base, cleaning the fruit, leaves and trunks. The foliage of the trees not visited by the snails is densely coated by the sooty mold. The snails have not confined themselves to the fungus alone, but have freed the trees from algæ, and apparently some of the lichens. The snails are even more widely scattered in some of the neighboring groves. The species is evidently native to the Florida Peninsula, having been recorded, according to Pilsbry, 'Manual of Conchology,' Vol. 12, 1899, from the mouth of the St. Johns River south to the Caloosahatchee River. The snails appear to have found their way naturally into the groves of the Manatee region. Mr. F. D. Waite, manager of the Manatee Lemon Company, observed their presence on one or two trees in the Willis grove as early as the summer of 1903, and they seem to have appeared in other groves at about the same

[1] Saprophytic in the sense that, although following and directly dependent upon various living insects, sustenance is derived from waste products thrown off from the bodies of these insects.

[2] Kindly identified for the writer by Dr. W. H. Dall.

time. It was not until the summer of 1905, however, that their spread became conspicuous. The snails are active in the early morning while the trees are moist from the dew of the previous night. During the afternoon they gather in sheltered parts of the tree, or under pieces of sacks placed in the tree for the purpose, and are easily transferred in this way from grove to grove. Snails thus introduced into the Harrison grove at Palmetto in March increased in numbers rapidly and thoroughly cleaned the tree on which they were placed by mid-summer.

Considering the fondness of the snails for the injurious saprophytic fungus *Meliola,* it becomes of first importance to inquire into their treatment of the beneficial parasitic fungi. Among the fungi parasitic on orange insects five species in particular are of inestimable benefit to the orange grower. These are: the 'brown fungus'; the red-pink fungus, *Aschersonia aleyrodis* Webber; a bright red fungus, *Sphærostilbe cocophila* Tul.; the 'gray-headed' fungus, *Opheonectria cocicola* and the 'black fungus.' The first two fungi named are confined to the white fly larvæ; the remaining three are parasitic on the common bark scales of the orange. The brown fungus in its mature stages throws out silvery white hyphæ over the surface of the leaf, and these intertwining with those of the neighboring pustules not infrequently entirely cover the lower surface of the leaf. The snails occasionally feed to a limited extent on these spreading hyphæ, but not so far as observed on the hyphæ of the pustule. Considering the very limited extent to which the snails feed on the hyphæ, it seems probable the spread of the fungus will not be interfered with by the snails. The brown fungus is, as a matter of fact, very prevalent on the trees visited by the snails. The red-pink fungus throws out short hyphæ only; the snails, so far as observed, in no way interfere with this fungus. The red fungus, *Sphærostilbe,* is also apparently untouched, as it is found growing abundantly on the orange trees along with the snails. No opportunity has yet occurred to observe the behavior of the snails towards the gray fungus. The black fungus,[3] however, is found abundantly along with the snails and is apparently untouched by them.

White fly infestation has been severe in the Manatee region for not less than fifteen years, and for an equal or greater time throughout much of the region given by Pilsbry as within the range of *Bulimulus Dormani.* That the snails should be found in orange groves in the Manatee region alone and should have occurred there in sufficient numbers to attract attention or to clean foliage and fruit only within the past three years is suggestive of possible change in food habits of the Manatee River variety of the species, or of an unexplained temporary or permanent reduction of its natural enemies in that locality. During the past winter the snails have been given such protection as they seemed to require, and have been generally distributed throughout some of the large groves in order to further test their usefulness in cleaning up the 'sooty mold' fungus.

E. H. Sellards.
University of Florida.

QUOTATIONS.

A NATIONAL DEPARTMENT OF HEALTH.

The government is designed for the welfare of the people, and in a government like ours, of the whole people, one of the first considerations in the people's welfare is their health; material resources are secondary. Without an able-bodied race, no country can prosper, and it is the favoring health conditions of the temperate zones that have made the races inhabiting them the rulers of the world. With the artificial conditions of civilization, however, the problem of the public health comes more and more to the front, and the old *laissez faire* methods show their deficiencies. More than one country at the present time is seeking methods and means to check the degenerative tendencies that threaten them, and the question whether our civilization is to last seems largely to depend on the success of these efforts.

[3] Recently identified as *Myriangium* sp., F. S. Earle, Ann. Rep. Office of Experiment Stations, 1903, pp. 457–8.

The paper of Professor Norton, published in this issue of *The Journal*, puts forth the economic side of the question as fully and fairly as any publication of its compass that has lately appeared. Coming from a non-medical man, it is an encouraging sign. Professor Norton shows how great a waste exists at the present time from preventable deaths, sickness and conditions of physical and mental inefficiency, due largely to the lack of a wise general governmental supervision. We have our pure food laws and our quarantine laws which go a certain way toward checking these evils, but they are, after all, only a beginning of what is needful. We have a great deal of government in regard to health matters, but it is local, unsystematized and often conflicting in different sections of the country and is distributed also, so far as it relates to national affairs, under different departments of the government, thus preventing the best results. The plea for a national department of health could be, to a certain extent, met by the consolidation under a single head of already existing bureaus without a great additional expense, but completeness and full efficiency would demand more than this.

The plan laid out by Professor Norton covers a much broader field, and, while it may not be absolutely realizable at once, the consolidation of the existing bureaus would be a great step in advance and could be enlarged on as wisdom and experience would dictate. The work done on less than a million and a half by the Public Health and Marine-Hospital Service is itself an indication of what a wise expenditure of only a moderate amount of public funds can accomplish. The protection of our southern coast from yellow fever, which it has practically accomplished, is worth annually many times the whole cost of that department, but this is a local service which principally benefits a section and not the whole country. An intelligent direction of health matters, including far more than that bureau at present has under its control, would be of still more widespread and general advantage. A considerable amount of the work done under the Agricultural Department, which is of the utmost value, including, for example, the admirable work of Dr. Wiley and that now assigned it under the pure food law, should properly be consolidated with the sanitary functions of other departments. Then a cabinet officer with expert knowledge of health matters could administer all these and other new departments to much better advantage than under the present system.—*The Journal of the American Medical Society.*

TECHNOLOGY—HARVARD GEOLOGICAL EXPEDITION.

DURING the past summer Professor Douglas Wilson Johnson, of Harvard University and the Massachusetts Institute of Technology, conducted a geological expedition through portions of New Mexico, Arizona and Utah. The expedition was supported by appropriations from both the Institute and Harvard University, together with contributions by several friends of the two institutions. Dr. H. W. Shimer, of the Institute geological department, and Mr. C. H. Decker, a graduate of the Columbia University School of Mines, were members of the party.

The first field work was done in New Mexico, where a week was spent in studying the geological relations of underground waters from the town of Belen eastward, while a week or more was devoted to a trip into the Mount Taylor volcanic district, where a somewhat extended detailed examination of the splendid volcanic necks was made.

The party then proceeded by rail to the Big Bug mining district, twenty-five miles southeast of Prescott, Arizona, where an outfit of wagons, horses and all necessary camp supplies was secured and final preparations made for an overland journey of twelve hundred miles, lasting from June 19 to September 10. Leaving Big Bug and crossing eastward to the Verde River, the ascent from the Basin Region to the Plateau Province was made near the head of Oak Creek, over what is known as the Mogollon Rim. Continuing north past Flagstaff, several days were spent in the San Francisco Mountain region, studying the glacial features in the main peak, and

the volcanic features associated with the more recent cinder cones and lava flows.

From here the party went to the Grand Canyon, making a three-days' trip down in the canyon with pack outfit, after which the journey eastward to the crossing of the Little Colorado and northward over the desert along the Echo and Paria cliffs, was begun. This proved to be the most strenuous part of the whole summer campaign, not so much because of lack of water—for which emergency due provision had been made—as because of the failure to secure sufficient feed for the five head of horses. From the Grand Canyon to the town of Kanab in southern Utah, a distance of more than 250 miles by the route traversed, the only grain available was a little corn at Tuba and one feed of oats at Lee's Ferry. The weather was intensely hot, the roads heavy with sand in many places, while grass fit for the horses to graze upon was only found at occasional places. As a result the horses got in poor condition, short days of travel and long rests were necessary, so that a large amount of time was consumed in this part of the journey. Kanab was reached on August 6.

From Kanab the party went north to Upper Kanab in order to visit the great terraces of the high plateaus of southern Utah. Returning to Kanab, a trip was then made to the southwest into the Toroweap Valley and the Mt. Trumbull region, for the purpose of tracing the relations of the Sevier and Toroweap faults, and the associated volcanic features. Returning as far as Pipe Spring, the party then turned westward, descending the Hurricane fault scarp west of Workman's Spring, and turning northward to the Virgin River. A delay of three or four days at this point was caused by a flood which was said to be the greatest ever known in the river's history.

Northward from the Virgin River the route passed along the margin of the Great Basin Province, at the foot of the western rim of the High Plateaus, through the towns of Toquerville, Beaver, Porowan, Holden, Nephi, etc. Good progress was made over splendid roads, notwithstanding frequent stops for side trips into many of the canyons which made possible a study of the northward continuation of the Hurricane fault, the character of the great Tertiary series and the volcanic beds, the undoubted evidence of recent faulting and other points of geologic and physiographic interest.

The outfit was sold in the towns of Provo and American Fork, just south of Salt Lake City. From the latter point Dr. Shimer went to the Yellowstone National Park for a few days, while Professor Johnson returned east by way of Butte, Montana. Mr. Decker will spend some time in the Bingham and Park City mining districts.

A detailed statement of the studies made in connection with the expedition, including reports on several special problems, will be published in the course of the winter.

PUBLICATIONS OF THE CARNEGIE INSTITUTION OF WASHINGTON.

The Carnegie Institution of Washington has issued a circular of its publications, which are as follows:

Index Medicus: A monthly classified record of the current medical literature of the world. Second Series. Edited by Robert Fletcher, M.D., and Fielding H. Garrison, M.D.

Year Book No. 1, 1902. Octavo, 351 pages.

Year Book No. 2, 1903. Octavo, 371 pages.

Year Book No. 3, 1904. Octavo, 305 pages, 6 plates.

Year Book No. 4, 1905. Octavo, viii + 303 pages, 7 plates.

No. 1. The Carnegie Institution of Washington, D. C. Octavo, 16 pages.

No. 2. Articles of Incorporation, Deed of Trust, etc. Octavo, 15 pages.

No. 3. Proceedings of Board of Trustees. Octavo, 15 pages. [The matter contained in Nos. 1, 2 and 3 is embodied in Year Book No. 1.]

No. 4. The Waterlilies: A monograph of the Genus Nymphæa. By Henry S. Conrad. Quarto, xiii + 279 pages, 82 text figures, 30 plates, including 12 plates colored to life.

No. 5. Catalogue of Double Stars. By S. W. Burnham. Quarto. In press.

No. 6. Desert Botanical Laboratory of Carnegie Institution. By F. V. Coville and D. T. MacDougal. Octavo, vi + 58 pages, 29 plates.

No. 7. New Method of Determining Compressibility. By T. W. Richards and W. N. Stull. Octavo, 45 pages, 5 text figures.

No. 8. Bibliographic Index of North American Fungi. By W. G. Farlow. Octavo. Vol. 1, part 1, xxxv + 312 pages.

No. 9. The Collected Mathematical Works of G. W. Hill. Quarto, 4 vols. Vol. 1, xviii + 363 pages; Vol. 2, vii + 339 pages; Vol. 3, 577 pages. Vol. 4 in press.

No. 10. Contributions to Stellar Statistics. On the Position of the Galactic and Other Planes Toward Which the Stars Tend to Crowd. By Simon Newcomb. Quarto, 30 pages.

No. 11. Production of Sex in Human Offspring. By Simon Newcomb. Octavo, 34 pages.

No. 12. The Action of Snake Venom upon Cold-blooded Animals. By Hideyo Noguchi. Octavo, 16 pages.

No. 13. Influence of Grenville on Pitt's Foreign Policy, 1787–1798. By E. D. Adams. Octavo, 79 pages.

No. 14. Guide to Archives of the Government at Washington. By C. H. Van Tyne and W. G. Leland. Octavo, xiii + 215 pages.

No. 15. Fecundation in Plants. By D. M. Mottier. Octavo, viii + 187 pages, 75 text figures.

No. 16. Contributions to the Study of the Behavior of the Lower Organisms. By H. S. Jennings. Octavo, 256 pages, 81 text figures.

No. 17. Traditions of the Arikara. By G. A. Dorsey. Octavo, 202 pages.

No. 18. Researches on North American Acridiidæ. By Albert P. Morse. Octavo, 56 pages, 8 plates.

No. 19. Coloration in Polistes. By Wilhelmine M. Enteman. Octavo, 88 pages, 6 colored plates, 26 text figures.

No. 20. The Coral Siderastrea radians. By J. E. Duerden. Quarto, v + 134 pages, 11 plates, 13 text figures.

No. 21. Mythology of the Wichita. By G. A. Dorsey. Octavo, viii + 351 pages.

No. 22. Report on the Diplomatic Archives of the Department of State, 1789–1840. By A. C. McLaughlin. Octavo, 73 pages.

No. 22. Revised edition.

No. 23. Heredity of Coat Characters in Guinea Pigs and Rabbits. (Paper No. 1, Station for Experimental Evolution.) By W. E. Castle. Octavo, 78 pages, 6 plates, 8 text figures.

No. 24. Mutants and Hybrids of the Oenotheras. (Paper No. 2, Station for Experimental Evolution.) By D. T. MacDougal, assisted by A. M. Vail, G. H. Shull and J. K. Small. Octavo, 7 pages, 22 plates.

No. 25. Evolution, Racial and Habitudinal. By J. T. Gulick. Octavo, xii + 269 pages, 5 plates.

No. 26. Exploration in Turkestan. By Raphael Pumpelly, W. M. Davis, R. W. Pumpelly and Ellsworth Huntington. Quarto, xii + 324 pages, 6 plates, 174 text cuts.

No. 27. Bacteria in Relation to Plant Diseases. By Erwin F. Smith. Quarto, xii + 285 pages, 31 plates, 146 text cuts.

No. 28. A Revision of the Atomic Weights of Sodium and Chlorine. By T. W. Richards and R. C. Wells. Octavo, 70 pages.

No. 29. The Color Sensitivity of the Peripheral Retina. By J. W. Baird. Octavo, 80 pages.

No. 30. Stages in the Development of Sium cicutaefolium. (Paper No. 3, Station for Experimental Evolution.) By G. H. Shull. Octavo, 28 pages, 7 plates, 11 text cuts.

No. 31. The Isomorphism and Thermal Properties of the Feldspars. Part I., Thermal Study; by A. L. Day and E. T. Allen. Part II., Optical Study; by J. P. Iddings. (With an introduction by G. F. Becker.) Octavo, 95 pages, 25 text cuts, 26 plates.

No. 32. Chimaeroid Fishes and their Development. By Bashford Dean. Quarto. In press.

No. 33. Researches in Stellar Photometry. By J. A. Parkhurst. Quarto. In press.

No. 34. American Fossil Cycads. By G. R. Wieland. Quarto. vii + 296 pages, 51 plates, 141 figures.

No. 35. Investigations of Infra-red Spectra: Part I., Infra-red Absorption Spectra; Part II., Infra-red Emission Spectra. By W. W. Coblentz. Octavo, 331 pages, 152 figures.

No. 36. Studies in Spermatogenesis with especial reference to the 'Accessory Chromosome.' By N. M. Stevens. Octavo, 32 pages, 7 plates.

No. 36. Studies in Spermatogenesis, Part II. By N. M. Stevens. Octavo. In press.

No. 37. Sexual Reproduction and the Organization of the Nucleus in certain Mildews. By R. A. Harper. Octavo, 104 pages, 7 plates.

No. 38. Writings on American History, 1903. Prepared under direction of A. C. McLaughlin. Octavo, 172 pages.

No. 39. Handbook of Learned Societies. Octavo. Vol. 1 (North and South America). In press.

No. 40. The Nucleation of the Uncontaminated Atmosphere. By Carl Barus. Octavo, xii + 152.

No. 41. Traditions of the Caddo. By G. A. Dorsey. Octavo, 136 pages.

No. 42. A Respiration Calorimeter with Appliances for the Direct Determination of Oxygen. By W. O. Atwater and F. G. Benedict. Octavo, 193 pages, 49 figures.

No. 43. Observed Position of Sun Spots. By C. H. F. Peters. (Edited by E. B. Frost.) Quarto. In press.

No. 44. Researches in Experimental Phonetics. Recording, Tracing, Measuring and Analyzing Speech Vibrations. By E. W. Scripture. Quarto. In press.

No. 45. Catalogue of Stars within two degrees of the North Pole, deduced from Photographic Measures. By Caroline E. Furness. Octavo, 85 pages.

No. 46. An Investigation into the Elastic Constants of Rocks, especially with reference to their Cubic Compressibility. By F. D. Adams and E. G. Coker. Octavo, 69 pages, 16 plates.

No. 47. Pulsation of Scyphomedusae. By A. G. Mayer. Octavo. In press.

No. 48. An Investigation of Evolution in Chrysomelid Beetles of the Genus Leptinotarsa. (Paper No. 4, Station for Experimental Evolution.) By W. L. Tower. Octavo. In press.

No. 49. Heredity of Hair-lenth in Guinea-pigs, and its Bearing on the Theory of Pure Gametes. By W. E. Castle and Alexander Forbes. (Paper No. 5, Station for Experimental Evolution.) The Origin of a Polydactylous Race of Guinea-pigs. (Paper No. 6, Station for Experimental Evolution.) By W. E. Castle. Octavo, 29 pages.

No. 50. The Relation of Desert Plants to Soil Moisture and to Evaporation. By Burton E. Livingston. Octavo, 78 pages, 16 text cuts.

No. 51. Studies on the Germ Cells of Aphids. By N. M. Stevens. Octavo, 28 pages, 4 plates.

No. 52. Inheritance in Poultry. (Paper No. 7, Station for Experimental Evolution.) By C. B. Davenport. Octavo, 136 pages, 17 plates.

No. 53. Egyptological Research. By W. Max Müller. Quarto, 62 pages, 106 plates.

No. 54. Research in China. By Bailey Willis. Quarto. In press.

No. 55. A Revision of the Pelycosauria of North America. By E. C. Case. Quarto. In press.

No. 56. The Energy Changes involved in the Dilution of Zinc and Cadmium Amalgams. By T. W. Richards and G. S. Forbes. Octavo. In press.

No. 57. The Roman Comagmatic Region. By H. S. Washington. Octavo. In press.

No. 58. Variation and Differentiation in Ceratophyllum. By Raymond Pearl. Octavo. In press.

No. 59. The Pawnee: Mythology. By G. A. Dorsey. Octavo. In press.

No. 60. Approximate Composition of the Hydrates formed by various Electrolytes in Aqueous Solutions. By Harry C. Jones. Octavo. In press.

No. 61. Changes in Free Energy of Iron under Varying Conditions, and the Occlusion of Hydrogen by Iron. By T. W. Richards and G. E. Behr. Octavo. In press.

No. 62. Condensation of Vapor as induced by Nuclei and by Ions. By Carl Barus. Octavo. In press.

No. 63. The Electrical Conductivity of Aqueous Solutions. By Arthur A. Noyes and others. Octavo. In press.

INSANITY IN ENGLAND AND WALES.[1]

According to the Sixtieth Report of the Commissioners in Lunacy for England and Wales, recently issued, the number of certified insane persons under care on January 1, 1906, in England and Wales was 121,979, of whom 9,802 were private patients, 111,256 pauper patients and 921 criminal lunatics. Of the total number, 89,342 were maintained in county and borough asylums, 17,742 in workhouses and metropolitan district asylums, 7,973 in registered hospitals, licensed houses and in naval and military hospitals, 776 were in the criminal lunatic asylum at Broadmoor, 528 were private single patients and there were 5,618 outdoor pauper lunatics.

The report shows a total increase in the number of the certified insane of 2,150 over the numbers of the previous year. This increase compares favorably with the increments of the three previous years, which were 2,630 for 1904, 3,235 for 1903 and 3,251 for 1902. Further, it is less by 404 than the annual average increase for the decennium ending December 31, 1905, namely, 2,554, and less by 657 than the average increase for the latter half of this decennium, namely, 2,807. Compared with 1904 the private patients have increased by 162, the criminal lunatics by 9 and the pauper patients by 1,979, the increase in the private patients being greater by 79, but the increase of the criminal lunatics being less by 26 and that of the pauper patients by

[1] From the *British Medical Journal.*

527, than in 1904. This shrinkage in the increase of pauper and criminal insanity, small though it may be, is highly satisfactory, and this is supported by the fact that in county and borough asylums the proportion of private patients to the total number therein has risen from 2.7 to 2.8 per cent. during the year. As to the fluctuations of pauper insanity in counties and boroughs the commissioners say that, as compared with the previous year, there has been in the 63 administrative counties a net increase in 40 counties amounting to 1,360 in all. In 20 counties there has been a net decrease amounting to 166, and in three counties —Hereford, Rutland and Somerset—neither increase nor decrease. London County shows by far the largest increase, amounting to 305. Middlesex, Essex, Kent, Surrey and the West Riding of Yorkshire, also show considerable increases. Of the 72 county boroughs an increase, amounting to 769 in all, occurred in 54, a decrease amounting to 109 in 14, and in 3—Chester, Hastings and South Shields—neither increase nor decrease. Of the 19 boroughs 11 showed an increase, amounting to 70 in all; in 7 there was a decrease, amounting in all to 31, and in 1 borough there was neither increase nor decrease.

Turning to the general question of the increase of insanity since 1859, the total number of certified insane has risen from 36,762 to 121,979, a rate of increase equivalent to 231.8 per cent., the general population having increased during the same interval at the rate of 75.4 per cent. Taking only the past ten years, there has been during that period a total increase of the certified insane of 26.5 per cent. This increase, however, is, as is shown by a table furnished by the commissioners, not only variable, but steadily declining—that is, the increase has been mounting more slowly for some years. Corresponding to this absolute increase, the ratio of the insane to population is increasing at a lessened rate. On January 1, 1906, the total certified insane in England and Wales stood to the estimated population in the proportion of 1 to 283, as contrasted with 1 to 285 of last year, 1 to 288 of 1903 and 1 to 314 of ten years ago—that is, the proportion of insane persons to the community, per 10,000, has risen from 31.89 to 35.31 during the decade. The increase in population during this period has been 10.8 per cent., and in the total number of insane under care 22.7 per cent. Thus, the number of insane persons under care, both numerically and relatively to population, is still steadily increasing, though, of course, this is not necessarily indicative of an increasing growth of actual occurring insanity. To this point we shall refer later. From the point of view of the ratepayers, however, this increase may be taken as an actual increase of insanity, particularly as the increase is practically confined to the pauper class. This is clearly brought out by Chart II., facing p. 6, showing the comparative variations in the proportion of the insane to total population from 1859 to 1906. In 1859 the ratio of private patients per 10,000 population was 2.38. This rose in 1879 to 2.97, then fell to 2.67 per 10,000 in 1897, since when it has risen slowly, and—with the exception of last year, when there was a drop of 0.01 per 10,000—steadily, to the present proportion of 2.84 per 10,000. The ratio of pauper lunatics, on the other hand, has risen without intermission from the 15.95 per 10,000 of 1859 to the present figure, for January 1, 1906, of 32.20 per 10,000. Doubtless the question of an actual increase of insanity is insoluble by purely statistical methods; but of these latter, the occurrence of insanity, as shown by the ratio of first admissions to population, furnishes the most reliable index. The commissioners' report does not contain information respecting this ratio for the years prior to 1898; but Table III., Appendix A, shows that in 1898 this ratio per 10,000 population was 4.92. This increased steadily to 5.76 in 1902, and since then has declined to 5.21, the ratio for 1905. Thus, so far as statistical evidence goes, these figures tend to show that for the last four years occurring insanity has not been on the increase relatively to population, and that the considerable absolute and relative increase of insane persons under care is to be explained by accumulation consequent on increasing

longevity of asylum inmates, increased certification, and so on.

THE LOWELL LECTURES.

Lectures under the Lowell Institute, Boston, are announced as follows:

The first course will be eight lectures by Percival Lowell, non-resident professor of astronomy at the Massachusetts Institute of Technology, director of the Lowell observatory, Flagstaff, Ar., and medalist (Mars) of the French Astronomic Society, on 'Mars as the Abode of Life.' (1) 'Planetary Evolution: the Conditions and Possibilities of Life.' (2) 'Natural Features of Mars.' (3) 'Geology and Areology: Mars and Glacial Epochs.' (4) 'Geology and Areology: Loss of Oceans and Growth of Deserts.' (5) 'Habitability: Probability of Life on Mars.' (6) 'Non-Natural Features: Canals and Oases.' (7) 'Metamorphoses of the Canals.' (8) 'Habitation: the Proofs of Life on Mars.' On Mondays and Thursdays, at 8 P.M., beginning October 15.

The second course will be eight lectures (in French) by M. le Dr. Pierre Janet, professeur de psychologie au Collége de France, directeur du laboratoire de psychologie de la Salpêtrière, on 'Psychotherapeutics or the Applications of Psychology to Therapeutics' (La psychothérapie, les applications de la psychologie à la thérapeutique). (1) 'Résumé Historique.' (2) 'Principe de la Psychothérapie. Influence des Etats Psychologiques sur la Santé Physique et Morale.' (3) 'Psychothérapie Générale, L'Exhortation Morale.' (4) 'Les Méthodes Suggestives.' (5) 'Les Méthodes D'Isolement et de Repos.' (6) 'L'éducation Motrice.' (7) 'L'éducation de la Sensibilité, l'Æsthésiogénie.' (8) 'Le Relèvement de la Tension Psychologique l'Education de l'émotivite.' On Tuesdays and Fridays, at 8 P.M., beginning October 23.

The third course will be eight lectures by Barrett Wendell, professor of English in Harvard University, on 'Contemporary France.' (1) 'The Universities.' (2) 'The Structure of Society.' (3) 'The Family.' (4) 'The French Temperament.' (5) 'The Relation of Literature to Life.' (6) 'The Question of Religion.' (7) 'The Revolution and Some of Its Effects.' (8) 'The Republic and Democracy.' On Mondays and Thursdays, at 8 P.M., beginning November 12.

The fourth course will be eight lectures by William James, professor of philosophy in Harvard University, on "The Movement Called 'Pragmatism' in Recent Philosophy." On Wednesday and Saturdays, at 8 P.M., beginning November 14.

The fifth course will be eight lectures by Alfred C. Haddon, Sc.D., F.R.S., university lecturer in ethnology, Cambridge, England, on 'The Melanesians: Racial Problems, Distribution of Culture, Social and Religious Evolution.' On Tuesdays and Fridays, at 8 P.M., beginning November 20.

The sixth course will be two lectures by William H. Furness, 3d, M.D., F.R.G.S., fellow of the Anthropological Institute of Great Britain and Ireland, etc., on 'The Kayan and Kenyah Tribes of Borneo, and the Natives of Uap in the Caroline Islands.' On Monday, December 10, and Thursday, December 13, at 8 P.M.

The seventh course will be eight lectures by Professor George E. Woodberry, on 'Poetic Energy.' On Tuesdays and Fridays, at 8 P.M., beginning January 8, 1907.

The eighth course will be eight lectures by Colonel Sir Colin Scott Moncrieff, LL.D., knight commander of the Star of India, etc., on 'The English in India and Egypt.' On Mondays and Thursdays, at 8 P.M., beginning February 4.

The ninth course will be eight lectures by Frank M. Chapman, curator of ornithology, American Museum of Natural History, New York City, on 'The Distribution of North American Birds.' On Tuesdays and Fridays, at 8 P.M., beginning February 5.

The tenth course will be six lectures by Charles Sedgwick Minot, D.Sc., LL.D., etc., James Stillman professor of comparative anatomy in the Harvard Medical School, on 'The Problem of Age, Growth and Death.' On Mondays and Thursdays, at 8 P.M., beginning March 4.

The eleventh course will be eight lectures

by Russell H. Chittenden, LL.D., professor of physiological chemistry and director of the Sheffield Scientific School of Yale University, on 'The Nutrition of Man.' On Tuesdays and Fridays, at 8 P.M., beginning March 5.

The twelfth course will be eight lectures by Albert Bushnell Hart, LL.D., professor of history in Harvard University, on 'The Real South.' On Mondays and Thursdays, at 8 P.M., beginning March 25.

SCIENTIFIC NOTES AND NEWS.

SIR WILLIAM PERKIN was entertained at a banquet at Delmonico's on October 6. Professor Charles F. Chandler presided and a number of speeches were made. Dr. Hugo Schweitzer read a paper describing the extraordinary chemical advances that had followed the discovery of mauve by Sir William Perkin fifty years ago. Dr. William H. Nichols presented the first impression of a gold medal established in honor of Sir William, which will be awarded each year for the most important discovery in applied science. A silver tea set was presented by Mr. Adolf Kuttroff and honorary membership in the American Chemical Society by its president, Dr. W. F. Hillebrand. Among other speakers were President Nicholas Murray Butler, Dr. H. W. Wiley and Professor Walther Nernst. Sir William Perkin replied, giving a most interesting account of his work in chemistry.

PROFESSOR S. F. EARLE has resigned the directorship of the Cuban Central Agricultural Station, which was organized in 1902.

DR. H. C. WOOD, for thirty years professor of therapeutics in the University of Pennsylvania and until 1902 clinical professor of diseases of the nervous system, has retired from the active duties of his chair, and has been made professor emeritus.

AT the recent Quebec Congress of Americanists, the following resolution was passed: "The International Congress of Americanists has learned with great regret that Dr. Albert S. Gatschet has been compelled to give up the continuation of his important investigations which he has carried on for many years, and expresses its admiration for the great services which he has rendered to Americanistic studies, particularly to those of Indian languages and of the ethnography of North America."

DR. HARRY FIELDING REID, professor of geological physics in the Johns Hopkins University, has sailed for Rome as the representative of the United States at the annual meeting of the International Seismographic Association.

AMONG the delegates to the celebration of the four hundredth anniversary of the foundation of the University of Aberdeen the following were mentioned in *Nature:* Professor H. Becquerel, Professor Behring, Dr. C. De Candolle, Professor Deissmann, Professor Yves Delage, Dr. Anton Dohrn, Professor A. Giard, Professor H. Höffding, Professor F. Hueppe, Professor Jensen, Professor Lombroso, Professor Matsumura, Professor Mendeléeff, Professor Menschutkin, Professor Hugo Münsterberg, Professor W. Ostwald, Professor Giuseppe Veronese, Professor Paul Vinogradoff, Professor J. W. Wijhe and Professor Weichselbaum.

DR. ARNOLD JACOBI, professor of zoology at the School of Forestry at Tharandt, has been appointed director of the Zoological and Ethnological Museum at Dresden, in succession to Dr. A. B. Meyer.

DR. A. PACZ, sometime private assistant to Professor Baskerville, has become chief chemist to the National Electric Lamp Company, Cleveland, Ohio.

MR. E. F. SCHRAMM, A.B. (Oklahoma, '06), who was elected to a fellowship in geology in the University of Nebraska, has had charge during the past season of a field party of the Morrill geological expedition under the direction of Professor E. H. Barbour, collecting Tertiary vertebrates in the Nebraska bad lands.

MR. CUSTER A. REED, A.B. (Oklahoma, '06), who is doing graduate work in paleontology at Yale, spent the greater part of the season studying water-supply conditions near East St. Louis for the Illinois Geological Survey.

DR. JAMES C. WELLS, adjunct professor of analytical chemistry at Columbia University,

has been given leave of absence for the coming year.

Dr. Philip P. Calvert, of the department of zoology, University of Pennsylvania, and Mrs. Calvert have just returned from a six weeks' tour in Mexico, where they collected information on the distribution of the Odonata on the northern part of the central plateau. These data will be incorporated in Dr. Calvert's section on the Odonata, now nearly finished, in the *Biologia Centrali-Americana,* edited by Mr. F. D. Godman, F.R.S. As members of the International Geological Congress, Dr. and Mrs. Calvert participated in the sessions of that body, at Mexico City, in September last.

Dr. W. B. Huff has resumed his work as head of the department of physics at Bryn Mawr College after a year spent at the Cavendish Laboratory, Cambridge.

Dr. O. Tetens, of the Samoa Observatory, has been appointed assistant in the Kiel Observatory.

Professor Neisser, of Breslau, expects to return next month to Java, to continue the experiments on syphilis.

Dr. John A. Brashear, of Pittsburg, will give the address at Lehigh University on Founder's Day, to be celebrated on October 11.

Professor Charles Baskerville, of the department of chemistry of the College of the City of New York, will give a course of six lectures on 'The Elements' in the Brooklyn Institute of Arts and Sciences every Tuesday evening from October 16 to November 27.

Professor A. E. Outerbridge, Jr., opened the meetings of the section of mining and metallurgy of the Franklin Institute, Philadelphia, on October 4, with a paper entitled 'Recent Progress in Metallurgy.'

Dr. Andreas Högyes, professor of pathology at Buda Pesth and founder of the Pasteur Institute in that city, has died at the age of sixty years.

The Chicago Academy of Sciences received $100,000 under the will of W. Moses Willner.

Under the name of Georg und Franziska Speyer-Haus, there has been established at Frankfort-on-Main a chemico-therapeutic institute, which has been placed under the direction of Dr. Paul Ehrlich.

We learn from *The British Medical Journal* that an institution bearing the name of 'Laboratoire Biologique du Radium' has been at work in Paris since July 1 under the direction of Dr. Louis Wickham, surgeon to St. Lazare. It is intended for the study of radium and its applications to medicine. The institution, thanks to the munificence of a wealthy manufacturing chemist, M. Armet de Lisle, is equipped on a lavish scale. It comprises a physical laboratory; a chemical laboratory; a laboratory of experimental medicine, pathology and bacteriology, and a clinical department, partly for gratuitous, partly for paying patients. Already, it is said, some interesting therapeutic results have been obtained.

A plea for the preservation of natural scenes and objects in Germany was put forward, says *Nature,* two years ago by Professor H. Conwentz, director of the West Prussian Provincial Museum at Danzig, in a work on 'Naturdenkmäler.' By Naturdenkmäler is meant the whole natural landscape, with its various soil formations, its water courses and lakes, its special plant and animal communities, as well as single rare species and individuals of the original flora and fauna. Professor Conwentz proposed that these results of nature's handiwork in the different states of the German empire should be placed on record so as to make them known, and that provision should be made for their protection. The Prussian minister of instruction has just consented to the establishment of a central office for this purpose. For the present the office will be at Danzig, and will be under the direction of Professor Conwentz.

On account of strikes and other delays, caused by the ventilation contracts, the completion of the new chemical laboratory of the College of the City of New York has been delayed. It is hoped to open the laboratory formally some time in the winter.

At the Harvard College Observatory a telegram has been received from Professor W. W.

Campbell, at Lick Observatory, stating that the seventh satellite of Jupiter was reobserved by Perrine Sep. 25.9962 G. M. Y. Its position angle was 119.1° and its distance was 2578″.

WE learn from *The Auk* that the annual meeting of the Maine Ornithological Society will be held at the rooms of the Portland Society of Natural History, Portland, Maine, on Friday and Saturday following Thanksgiving day.

THERE will be a civil service examination on November 14, to fill the position of aid (male) in zoology, in the department of biology of the U. S. National Museum at a salary of $720; there will also be a civil service examination on November 7 and 8 for topographic draftsman on the Isthmus of Panama, at salaries of $100 and $125 a month.

AT the meeting of the 'Conference on Home Economics' held at Lake Placid during the second week of September a letter was read from Mr. LeBosquet proposing that the Public Health and Marine Hospital Service should issue popular bulletins for the information of the public on health matters. Extracts from the letter proposing a National Board of Health were read. The conference voted that its secretary should communicate with President Roosevelt expressing the approval of the conference both of the plan for the distribution of circulars of information by the Public Health and Marine Hospital Service and for the establishment of a National Department of Health to coordinate and extend the work already being done by the national government. At this conference Professor Irving Fisher, of Yale University, presented the results of experiments made at Yale University during the last college year directly to ascertain the effect of change of diet upon working power. The experiment was conducted on nine healthy students who volunteered for the purpose and was based upon the previous experiments of Professor Chittenden. After four and a half months it was found that the men on the average had doubled their physical endurance, as shown by gymnasium tests, which they had at the beginning of the experiment in January. This great increase is ascribed entirely to dietetic causes, as no other factors which were likely to increase endurance were known to be present. The change in diet was not through any food prescription, but was brought about by following in an entirely natural manner three rules, the first two of which are Mr. Fletcher's; first, thorough mastication of food, with the attention on the taste and enjoyment of food, not on the mechanical act of mastication; second, implicit obedience to the appetite, both in regard to the kind of foods consumed and quantity; third, when appetite consented, but not otherwise, the fullest benefit of the doubt was given to low proteid foods rather than meats and other high proteid foods. At the end of the experiment the men had reduced their proteid to about the level shown by Professor Chittenden to be the normal required.

AN interesting address on educational methods and their relation to science and industry, with particular reference to pottery, was delivered by Professor H. E. Armstrong in the Town Hall, Longton, on September 19. In the course of his remarks, according to an abstract in *Nature*, he said that workers in science have evolved a method, the scientific method, involving the gradual and cautious passage from the known to the unknown. Workers in politics have no such method at their disposal. Too often they are more or less ignorant of the real nature and extent of the problems which they deal with and seek to solve; sentiment masters their actions. The application of scientific method to public affairs is, consequently, becoming a matter of paramount importance. In all manufacturing districts science and industry must be brought into an effective alliance. On no other basis are prosperity and happiness possible, for the simple reason that, in these days, an industry that does not repose on a scientific basis is one which has no proper knowledge of itself, science being nothing more than organized systematic knowledge. Scientific training, training in method, is required by all. Scientific knowledge, true knowledge, must be public possession. The feeling is becoming general that

something must be done to make our schools more effective than they are. In a recent report of the Consultative Committee, the Board of Education is advised that the schools have failed, in the past, to develop both the moral and mental qualities which are desirable, and that we must now strive to make the teaching far more practical, manual training being openly and strongly advocated. We read, moreover, "It would seem clear to the committee that the thing needed is not only knowledge, but a right attitude of mind, a mind confident in its own power to observe and think, and in the habit of observing and thinking—a mind in which interest makes for intelligence and intelligence for interest." "The course," it is stated, "should consist of three threads or strands, roughly to be termed humanistic, scientific and manual, and, in the case of girls, domestic; all higher elementary schools should give this threefold instruction." Though these views have been urged by many educational reformers for thirty years or more, the doctrine they involve is really quite revolutionary coming from such a quarter, especially as it is directed to the Board of Education, which treats manual training as a special subject for the select few.

UNIVERSITY AND EDUCATIONAL NEWS.

The new building for the engineering department of the University of Pennsylvania will be dedicated on October 19.

The Princeton correspondent of the *Evening Post* writes: "The handsome new faculty room in Nassau Hall is now completed, and the university faculty holds its meetings there. The room is finished in old English quartered oak panelling, and the faculty, when in session, are seated on long benches on each side of the room, facing each other, after the manner of the seating of the English House of Commons. The room has been refitted from a fund left by the late Augustus Van Wickle, a descendant of Nathaniel Fitz Randolph, who gave the original Princeton campus, on which Nassau Hall is situated. This hall is eventually to become the administrative building of the university, the offices of administration to be grouped about the main faculty room. It was in the room now used by the faculty that Congress met for five months in 1783, Nassau Hall being at that time the capitol of the new republic. In the historic room a special audience was given to Washington; there also the minister of the Netherlands, General Lafayette and nearly all the prominent public men of America were received."

Dr. James Barnes, instructor in physics at the Johns Hopkins University, has been appointed associate in physics at Bryn Mawr College.

The following promotions and appointments have been made in the chemical department of the College of the City of New York: Assistant Professor H. R. Moody, Ph.D., to be associate professor in charge of analytical chemistry; Instructor L. H. Friedburg, Ph.D., to be assistant professor in charge of organic chemistry; Mr. Reston Stevenson, M.S. (North Carolina), formerly assistant in Cornell University, to be tutor in analytical chemistry; Mr. W. A. Whitaker, Jr., M.S. (Columbia), to be tutor in general chemistry; and Mr. Lorenz Sporer, B.S. (Hobart), to be assistant tutor in the same subject.

At Boston University Assistant Professor Arthur W. Weysse and Lyman C. Newell have been made professors of biology and of chemtry, respectively.

Professor George V. N. Dearborn, of Tufts College, has been appointed lecturer and instructor in the relations of body and mind in the Sargent School of Physical Education, Cambridge.

Dr. G. Hauser, professor of pathology at Erlangen, has declined a call to Würzburg, in succession to Dr. von Rindfleisch.

At University College, London, the following appointments have been made: Mr. A. Wolf, D.Litt., assistant professor of philosophy; Mr. V. H. Blackman, M.A., lecturer in plant cytology in the department of botany; Mr. N. G. Dunbar, demonstrator in the department of applied mathematics; Messrs. E. Foxell, W. H. Gibson and H. E. Watson, assistant demonstrators in the department of chemistry.